Honey Did You Hear Me?
*Testing for Hearing in the Office*

Theresa Hnath Chisolm, PhD
*Geriatric Psychiatry*
for the Primary Care Provider
*August 2, 2009*
Clearwater Beach, FL

Department of Communication Sciences & Disorders
College of Behavioral & Community Sciences
University of South Florida
tchisolm@bcs.usf.edu

---

Hearing Screening
in the
Primary Care Setting

"Now we're just relax, and the doctor will begin your hearing test in just a mom. en..."
You have been treating a 79 y/o male in your primary care practice for hypertension and osteoarthritis for the last 10 years.
He comes to see you in your office for a routine annual checkup.
You decide to screen him for hearing impairment and ask him whether he feels that he has hearing difficulty.
He replies no.

What do you do next?

Answer the question
Reviewing the evidence
Best practices for screening and management of adult hearing loss in the primary care setting
3rd most common chronic health condition in older Americans (Chruikshanks et al., 1998)

- 25%-40% of the population > 65 y/o is hearing impaired
- Prevalence increases as age increases
  - > 75 y/o: 40-66% have hearing loss
  - > 85 y/o: > 80% have hearing loss

**Importance of Hearing Screening**

- Hearing Loss ➔ Frustration
  - Associated with
    - Sadness and depression
    - Worry and anxiety
    - Paranoia
    - Emotional turmoil and insecurity
Hearing Loss in Older Adults results in an increased likelihood of....

- Depression:
  - Odds Ratio = 1.8 (95% Confidence Interval: 1.1-2.7)

- Decreased Self-sufficiency in Activities of Daily Living:
  - Odds Ratio = 2.1 (95% Confidence Interval: 1.4-3.2)

(Carabellese, Appollonio, Rozzini et al., 1993)

---

**Hearing Loss and Dementia**
(Uhlmann, Larson, Rees, Koepsell & Duckert, 1989)

<table>
<thead>
<tr>
<th>Hearing Loss, dB</th>
<th>Adjusted Odds Ratio</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild (20-39)</td>
<td>1.5</td>
<td>0.4-5.4</td>
</tr>
<tr>
<td>Moderate (30-39)</td>
<td>2.2</td>
<td>0.6-7.8</td>
</tr>
<tr>
<td>Moderate/severe (≥40)</td>
<td>4.1</td>
<td>1.1-15.8</td>
</tr>
</tbody>
</table>

*Odds ratio was adjusted for family history of dementia, depression diagnosis, number of prescription medications, and source of primary care. Reference odds ratio for normal hearing (<20-dB loss) is 1.0. Trend of increasing risk of dementia for increasing level of hearing loss is statistically significant (P<.05).*
Hearing Loss in a Memory Disorders Clinic (Gold, Lightfoot & Hnath-Chisolm, 1996)

- n = 52 patients
  - n = 30 – probable Alzheimer’s Disease
  - n = 22 – other forms of cognitive impairment

- 49 failed a hearing screening

- Prevalence of hearing loss is much greater in older individuals with probable memory disorders, including AD, than in the general population of older adults

Comparison of Symptoms (Chartrand, 2001)

<table>
<thead>
<tr>
<th>Alzheimer’s Disease</th>
<th>Untreated Hearing Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression, anxiety, disorientation</td>
<td>Depression, anxiety, feelings of isolation</td>
</tr>
<tr>
<td>Reduced language comprehension</td>
<td>Reduced communication ability</td>
</tr>
<tr>
<td>Impaired memory</td>
<td>Lessened cognitive input</td>
</tr>
<tr>
<td>Inappropriate psychosocial responses</td>
<td>Inappropriate psychosocial responses</td>
</tr>
<tr>
<td>Loss of ability to recognize</td>
<td>Lessened mental scores</td>
</tr>
<tr>
<td>Denial, defensiveness, negativity</td>
<td>Denial, heightened defensiveness, negativity</td>
</tr>
<tr>
<td>Distrust, suspiciousness of others</td>
<td>Distrust, paranoia re: others are talking about them</td>
</tr>
</tbody>
</table>
Confounds the diagnosis and clinical presentation of dementia

Exacerbate the behavioral manifestations

Weinstein & Ansel (1986)
  - 83% of patients had at least a mild hearing loss
  - 33% of these patients were reclassified to a less severe dementia when mental status was assessed with patients using a handheld personal amplifier.

Only 9% of internists offer hearing tests to patients 65 years and older (US Dept of Health & Human Services, 1997)

Only 25% of older individuals who could benefit from hearing aids use them (Gates et al., 1990; Kochkin, 1997)

Meta-analytic systematic review – hearing aids improve QoL (Chisolm et al., 2007)
Primary Care Physician

- Screen
- Recognize
- Treat
- Appropriately refer

Anatomy & Physiology

Aging Auditory System
(e.g., Chisolm, Willott & Lister, 2004)
Middle Ear

Inner Ear
External Ear

- Function largely protective
- May provide passive enhancement (5–15 dB) of high frequency sounds
Age-related changes in the External Ear

- Excessive cerumen
- Hair growth
- Collapsed ear canal
- Changes in the physical properties of the skin
- Enlargement of the pinna

Little to no impact on functional hearing
Amplifies sound pressure by 20–30 dB

Whispered Speech vs. Normal Conversation
Incudostapedial
Incudomalleolar

Degenerative changes associated with osteoarthritis

Age-Related Changes in the Middle Ear

Middle Ear Abnormalities in Patients with Osteoarthritis (Rawool & Harrington, 2007)

- Patients with osteoarthritis and no hx of family hearing loss, noise exposure or chronic middle ear disease
- Higher prevalence of middle ear abnormalities and hearing loss
- Than age-matched controls without arthritis
- Osteoarthritis and hearing loss are among the top chronic health conditions of older adults, the relationship between the two is worthy of note
- Suggests need for routine assessment of hearing in patients suffering from osteoarthritis, age 65+
Inner Ear

- Vestibular components
- Hearing Components
  - Cochlea
  - Auditory nerve

Cochlea
Cochlea

- 3 fluid filled channels
  - scala vestibuli
  - scala tympani
  - scala media

Organ of Corti
Organ of Corti

Inner Hair Cells

Outer Hair Cells

Tontopically Organized
Sound transduction

A

B
t

C

t

D

t

medial geniculate body
inferior colliculus
lateral leminiscus
superior olivary complex
cochlear nuclei
auditory nerve
Age–Related Changes in the Inner Ear

- Progressive Degeneration:
  - Sensory
  - Neural
  - Vascular
  - Supporting Cells
- Changes in:
  - Synaptic
  - Mechanical

Age–related changes

- Inner Ear
- Central Auditory System
- Cognitive Processes
Presbycusis
Age-related Hearing Loss

- Sensorineural
  - Inner ear (sensory)
  - Auditory nerve (neural)
- Gradual onset
- Slowly progressive
- Greater hearing loss for higher frequency sounds
Elevated thresholds

Reduces speech understanding in noisy and reverberant environments

Interferes with the perception of rapid changes in speech

“I can hear people talking but can’t understand what they are saying”

“If they spoke slower (or clearer), I could understand what they are saying”

Classic Complaints
Evaluating Hearing

- Complete hearing evaluation
- Thresholds for frequencies between 500-8000 Hz
- The ability to recognize speech in quiet and noise
- 30-60 minutes
- Specialized equipment in a sound-protected setting

Screening for Hearing in the Primary Care Setting
Professional Organization Recommendations

Table 1. Summary of Recommendations from Professional Organizations for Hearing Loss Screening

<table>
<thead>
<tr>
<th>Professional Organization</th>
<th>Frequency</th>
<th>Screening</th>
<th>Examination and Audiometry</th>
<th>Other Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child &amp; Family Services Task Force®</td>
<td>Periodically</td>
<td>Recommended</td>
<td>Recommended for patients with evidence of significant hearing loss</td>
<td>Recommended or against</td>
</tr>
<tr>
<td>Canadian Task Force on Preventive Health Care</td>
<td>Early life to childhood</td>
<td>Recommended</td>
<td>Not discussed</td>
<td>Unpublished, single-screening study found no reported hearing loss</td>
</tr>
<tr>
<td>American Academy of Family Physicians</td>
<td>Adults &gt;70 years of age</td>
<td>Recommended</td>
<td>Not discussed</td>
<td>None</td>
</tr>
<tr>
<td>American Speech-Language-Hearing Association</td>
<td>Adults &gt;70 years of age</td>
<td>Recommended</td>
<td>Not discussed</td>
<td>None</td>
</tr>
</tbody>
</table>

From Yeuh et al., 2003

Screening for Hearing in the Primary Care Setting

(Borgardus et al., 2003; Yeuh et al., 2003; Bagai et al., 2006; Davis et al., 2007; Yeuh et al., 2007)

- Scientific reviews, clinical trial, cost-benefit analysis of hearing screening protocols
- 2-component approach to hearing screening
  - Self-report screening questionnaire
  - Handheld sound generator
Asking the question

- Simply asking patients about hearing loss is helpful
- If patients say they have difficulty, referral for a hearing evaluation is warranted
- But
  - Some patients may be reluctant to admit they have hearing problems or may not notice the problem
  - Some patients have no trouble in quiet settings, but do have difficulty in noise

Whispered Voice Test

Box 1: Conducting the whispered voice test

- Whispering numbers & letters from behind the patient
- Patient repeats
- Test ears individually, occluding the non-test with a finger, rubbing the tragus in a circular motion
Whispered Voice Test

- Simple & inexpensive
- Failure increases the likelihood of the presence of a hearing loss
- Subjective, difficult to standardize

Box 1: Conducting the whispered voice test

- The examiner stands arm's length (~0.6 m) behind the seated patient and whispers a combination of numbers and letters (e.g., 4-K-2) and then asks the patient to repeat the sequence.
- The examiner should quietly exhale before whispering to ensure a quiet voice as possible.
- If the patient responds correctly, hearing is considered normal, if the patient responds incorrectly, the test is repeated using a different number/letter combination.
- The patient is considered to have passed the screening test if they repeat at least three out of a possible six numbers or letters correctly.
- The examiner always stands behind the patient to prevent lip-reading.
- Each ear is tested individually, starting with the ear with better hearing, and during testing the non-test ear is masked by gently occluding the auditory canal with a finger and rubbing the tragus in a circular motion.
- The other ear is assessed similarly with a different combination of numbers and letters.

Tuning Fork Tests

- Weber
  - Better vs. Poorer Ears
  - Not useful in identifying individuals with bilateral conductive (outer or middle ear) or sensorineural hearing loss

- Rinne
  - Identify conductive hearing loss

- 256 Hz & 512 Hz
Screening for Hearing in the Primary Care Setting
(Borgardus, et al., 2003; Yeuh et al., 2003; Bagai et al., 2006, Davis et al., 2007; Yeuh et al., 2007)

- Self-report screening questionnaire
  - Functional impact of hearing loss

- Handheld sound generator
  - Physiological assessment of hearing

Hearing Handicap Inventory for the Elderly – Screening Version (Ventry & Weinstein, 1983)

<table>
<thead>
<tr>
<th>Item</th>
<th>Question</th>
<th>Yes (4 points)</th>
<th>Sometimes (2 points)</th>
<th>No (0 points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Does a hearing problem cause you to feel embarrassed when meeting new people?</td>
<td>No (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Does a hearing problem cause you to feel embarrassed when listening to members of your family?</td>
<td>No (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Do you have difficulty hearing when you are in a crowd?</td>
<td>No (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Do you feel embarrassed by a hearing problem?</td>
<td>No (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Do you have difficulty hearing when you are talking to a group of people?</td>
<td>No (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Do you feel embarrassed by your hearing loss or changes in your personal or social life?</td>
<td>No (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Do you have difficulty hearing in a conversation with relatives and friends?</td>
<td>No (6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Score: __________
Hearing Handicap Inventory for the Elderly – Screening Version (Ventry & Weinstein, 1983)

- Scores range from 0-40

<table>
<thead>
<tr>
<th>Score</th>
<th>Probability of Hearing Impairment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-8</td>
<td>13%</td>
</tr>
<tr>
<td>10-24</td>
<td>50%</td>
</tr>
<tr>
<td>26-40</td>
<td>86%</td>
</tr>
</tbody>
</table>

- Cut-off scores of 10 and above provides both reasonable sensitivity and specificity (0.63-0.80 for both)

Physiological Screening

- Hand-held combination otoscope and audiometer
- Delivers pure tones at 25 dB and 40 dB HL:
  - 500 Hz
  - 1000 Hz
  - 2000 Hz
  - 4000 Hz
Physiological Screening

- Tones presented at each frequency
- Patient indicates if he or she hears the tone
- Minimal training needed to use
- Can directly inspect the ear canal
- Studies compared screening at 40 dB HL to standard audiometric testing
  - Excellent sensitivity (>0.94)
  - Good specificity (0.69-0.80)
- RECOMMEND: Screen at 2k Hz or 1k and 2k Hz

Automated Hearing Screener
Automatic Screening Instrument

- Fast, accurate, simple and hygienic. The test can be performed by General Practitioners and nurses in a mere 30 seconds per ear and the results are available immediately.
- With pressing 1 button, hearing is screened at:
  - 1 kHz at 55, 35 and 20 dB HL
  - 3 kHz at 75, 55 and 35 dB HL
- Patient indicates/counts tones heard
  - All 6: probably not suitable for hearing aid, may benefit from advice
  - 3, 4 or 5: may be suitable to assess & fit for hearing aids
  - 0, 1, 2 or asymmetry: need full assessment

Referral After Screening

- Self-reported hearing problems
- Fails a hearing screening
- Referred for further evaluation to an otolaryngologist or audiologist
- To determine the need for further testing, medical, surgical, or rehabilitative management
Intervention for Age–Related Hearing Loss

- Conductive Hearing Loss
  - Medical/Surgical Intervention

- Sensorineural Hearing Loss
  - Rehabilitative intervention including hearing aids, and if not responsive to hearing aid rehabilitation, consideration for cochlear implants

Efficacy of Hearing Aid Intervention

- Randomized Controlled Trials
  - e.g., Mulrow et al., 1990; Mulrow et al., 1992; Jerger et al., 1996

- Improvements
  - Emotional function
  - Social function
  - Communication function
  - Cognitive function

- Lessening of depression
- Sustained for up to 1 year of hearing aid use
**Summarize**

- Age-related hearing loss is highly prevalent
- Untreated, many negative consequences
- Efficacious treatments are available
  - Medical and surgical treatments for conductive disorders
  - Rehabilitative interventions (e.g., hearing aids, assistive devices, cochlear implants) for sensorineural hearing losses
- Inexpensive and effective hearing screening methods are available
You have been treating a 79 y/o male in your primary care practice for hypertension and osteoarthritis for the last 10 years. He comes to see you in your office for a routine annual checkup. You decide to screen him for hearing impairment and ask him whether he feels that he has hearing difficulties. He replies no. What would you do next?

As we listen to the next presentation...
References